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### Re: **regenerative** braking device

... On conventional heat engine powered cars, **regenerative** braking is even more difficult

to implement efficiently. As shown above, the **friction brakes** are still ...

[sci.energy](#) - Oct 14, 1998 by Don Borowski - [View Thread](#) (1 article)

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### Re: How does **regenerative** braking work?

... t the energy go into the **brakes** and cause **friction** and heat? how much energy does

the **brakes** produce? is it a significant amount? **Regenerative** braking takes ...

[rec.autos.tech](#) - Feb 26, 2000 by Supertimer - [View Thread](#) (6 articles)

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### Re: Flywheel batteries as EV power source

... I was using flywheel power and **friction brakes** energy need. Then I would calculate

the 'what if I was using flywheel power and **regenerative brakes** energy need ...

[sci.electronics](#) - Dec 23, 1992 by Ted\_Eugene\_Viens@cup.portal.com - [View Thread](#) (195 articles)

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### Re: Insight question

... Braking with the **regenerative/friction** system of the Insight will recover some amount of ... If your driving pattern means you are hitting the **brakes** even less ...

[rec.autos.makers.honda](#) - Mar 5, 2001 by Arthur Russell - [View Thread](#) (9 articles)

### Re: Electric Car Batteries?

... of regenerative braking falls off with vehicle speed, EVs will have to be fitted with

conventional hydraulic **friction brakes** as well as with **regenerative** systems ...

[sci.environment](#) - Sep 8, 1995 by Bruce Hamilton - [View Thread](#) (95 articles)

### Re: **Regenerative** Braking

... Dust from **brakes** is a problem in all ... **friction** material that has brilliant **friction** characteristics, and ... To use **regenerative** braking the following problems have ...

[misc.transport.urban-transit](#) - Jun 15, 1995 by Brendan Sothcott - [View Thread](#) (20 articles)

### Re: Hybrid Cars

... The **regenerative** unit is mounted where the existing **friction** disk/drum **brakes** are, and is two compartments with a sealed pressurised vane pump, The working ...

[sci.energy](#) - Jun 25, 1994 by hamilton\_b@ix.wcc.govt.nz - [View Thread](#) (98 articles)

### Re: Linear motors

... many G's can be pulled when using LIM for **regenerative** braking? More g's than a standing passenger will accept, particularly if combined with **friction brakes**. ...

[misc.transport.urban-transit](#) - Nov 14, 1999 by James Robinson - [View Thread](#) (123 articles)

### Re: Regeneration

... (for example the **regenerative brakes** in various ... be able to stop the train even if the overhead wire is not operational (eg by application of **friction brakes**). ...

[misc.transport.rail.americas](#) - Nov 15, 1998 by tk2@rcs.urz.tu-dresden.de - [View Thread](#) (5 articles)

### Re: Life saving Vacuum Rail **brakes**- They STOP!!! In 1/5 the ...

... EVs have **regenerative** braking for high speeds that can extend their ... distance, which depends on the coefficient of static **friction** for conventional **brakes**. ...  
[rec.autos.misc](#) - Dec 27, 1994 by Bruce Hamilton - [View Thread \(121 articles\)](#)

### Re: Do Electric Cars Pollute More? (Was: Re: Lightbulbs)

... to the ambient environment at a total loss, as in **friction brakes**; (b) [central ... and then dump to ambient as above; (c) [central electric, **regenerative**]: as in ...  
[rec.autos.misc](#) - Jun 8, 1994 by Barry Smith - [View Thread \(94 articles\)](#)

### A ride on the Red Line

... controller. Braking: Blended electric and **friction brakes**. Electric: Dynamic and **regenerative**. Traction motors act as generators. ...  
[rec.railroad](#) - Feb 16, 1993 by Ed Suranyi - [View Thread \(7 articles\)](#)

### Re: Conservation of Energy?

... watch that flyback voltage!!) would be used for the **brakes**. ... not get maximum braking performance from a **regenerative** system. So you also need a **friction** system. ...  
[sci.engr.mech](#) - Feb 21, 1995 by Soren LaForce - [View Thread \(10 articles\)](#)

### Re: FAQ CalTrain Safety r 0.9

... Even trains equipped with the state of the art in braking, a combination of 3 braking systems (multi-disk **friction brakes**, dynamic/**regenerative brakes** and eddy ...  
[ba.transportation](#) - Feb 16, 1996 by Adrian Brandt - [View Thread \(4 articles\)](#)

### Re: **Regenerative** Braking in subways

... How can dynamic or **regenerative brakes** be used on these??? ... During braking, normal electropunmatic (**friction**) brake is provided on the trailers. ...  
[misc.transport.urban-transit](#) - Jun 11, 1995 by Brendan Sothcott - [View Thread \(13 articles\)](#)

### Re: Magnetic Train **Brakes**

... electro-magnet onto the rails and create **friction** there without ... of 2.73 m/s<sup>2</sup>. Eddy current **brakes** are not ... limits the force of the **regenerative brakes** at high ...  
[misc.transport.rail.europe](#) - Jun 25, 1998 by tk2@rcs.urz.tu-dresden.de - [View Thread \(14 articles\)](#)

### Re: Electric Vehicles

... To help this situation, eliminate the ICE and **friction brakes**. Use a fuel cell and **regenerative** braking, and \*make sure\* that you do not deliberately reject ...  
[sci.environment](#) - Dec 5, 1998 by charlieW - [View Thread \(263 articles\)](#)

### Re: Electric Vehicles: Why all the skepticism?

... vehicle instead of wasting it away in **friction** and heat ... redundant systems - 1/2 for the front **brakes** and the ... If you're going to do **regenerative** braking, be sure ...  
[sci.energy](#) - Nov 25, 1994 by Technologist - [View Thread \(128 articles\)](#)

### Re: Energy recovery

... Its use is however limited for two primary reasons: 1 Many drivers do not like the "feel" of **regenerative** braking, and prefer to use **friction brakes**. ...  
[uk.railway](#) - Jan 13, 2001 by Aaron Taylor - [View Thread \(106 articles\)](#)

### Re: Seeking better **brakes**

... a bit and perhaps function with less **friction** as a ... motion machine or some sort of miracle **regenerative** metal alloy. ... t, what does one's choice in **brakes** have to ...  
[rec.bicycles.tech](#) - Mar 29, 2000 by Hugh N. B. Flynn - [View Thread \(56 articles\)](#)

### Re: **Regenerative** braking and temperature

... stock) both dissipate the energy as heat Silly me, for not realising (in my earlier post) that **friction brakes** make heat! whereas **regenerative** would dissipate ...  
[uk.transport.london](#) - Nov 26, 1998 by Richard Griffin - [View Thread \(10 articles\)](#)

### Re: Electric Vehicles

... get close to 100% efficiency, since the breaking ability of **regenerative brakes**, drops dramatically ... for will still need to come from standard **friction** breaks. ...  
[sci.energy](#) - Nov 23, 1994 by Mark.O.Wilson - [View Thread \(162 articles\)](#)



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From: Technologist ([secret@services.win.net](mailto:secret@services.win.net))  
Subject: Re: Electric Vehicles: Why all the skepticism?

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In article <hatunenCzJEA1.C4D@netcom.com>, hatunen@netcom.com says...

>[snip]

>

>> Actually **regenerative** braking can reduce weight by eliminating normal brake  
>>systems completely freeing up hundreds of pounds. Switched reluctance  
>drives

>This sounds like a bit of an overestimate with respect to normal brake  
>systems.

>I'd give you, \*possibly\*, 100 lbs. wrapped up in **brakes** for the typical  
>auto. Some of it performs a double duty, as both brake rotor and wheel hub.

The mass and strength of those double duty parts are greatly increased just to transfer and dissipate the heat generated in breaking.

I agree at first 200 pounds does sound high but if you think of all the components it adds up quick. I know on my Vette and Typhoon the rotor alone weighs in at a good 25 pounds each and on both vehicles with the rotor removed the tire can still be mounted without them. The caliper assembly, bracket and brake pads add another 8-10 pounds per wheel. The master cylinder, power head assemblies and supporting bracket that enters the firewall under the hood alone weigh in at 40 pounds. 30 feet of filled metal break pipes, lines and 18 small brackets to hold it. Weigh in at least 8 pounds in total. The anti lock unit, computer and lines add another 25 pounds.

I haven't counted that the structural frame, tire load, springs, and shocks could all be built lighter with 200 pounds less weight (this should be added when building a new vehicle from scratch). Also the 35 pounds less sprung weight per wheel would be of benefit to the suspension and ride. The reduced angular momentum from 25 pounds less rotational mass from the removed rotors or drums would also help with the acceleration and braking of the vehicle. 200 pounds is real for an average IC car. But 100 pounds might be accurate for a 1,500 pound car.

>

>

>Please give the engineers who design these systems a \*little\* credit, at  
>least!

They saved millions of lives and every person should thank **brakes** and the engineers who built them for saving his or her own life thousands of times. But conventional **brakes** were just a temporary solution to a problem. Very soon braking energy will be saved to re-accelerate a vehicle instead of wasting it away in **friction** and heat.

>  
>And, do you really trust a lot of electronics/software as much as a simple  
>mechanical system? Didn't think so :-)  
>Since about 1967, cars have redundant systems - 1/2 for the front **brakes**  
>and the other 1/2 for the back. One system can fail with the other providing  
>(reduced) braking capability.  
>  
>If you're going to do **regenerative** braking, be sure to including redundancy -  
>possibly one system/processor for the front, the other for the back, or,  
>since 8 bit PUS are so cheap nowadays, one processor per wheel.

Actually **regenerative** braking can be built as safe or safer than conventional **brakes** with dozens of redundant mechanisms, antilock braking anti-skid traction control. An electric vehicle with **regenerative** braking could have 4 separate braking motors. With a reluctance switching motor, numerous windings per motor create redundant protection within each motor, with the ability for the motor to run and brake even with several of the windings burnt out.

When a vehicle is made "Ultra aerodynamic"- air drag, normally the biggest drag on a cars range and efficiency becomes greatly reduced and braking losses then become magnified in comparison. To the point that braking losses become a huge issue not normally though significant. Even today **regenerative** braking now has been demonstrated to add as much as 25% to an electric vehicles range.

>  
>If you don't want a redundant system, please at least put a small set of  
>pads on the vehicle, just in case you get a SEU of some sort...

Those small pads could double as emergency **brakes**.

>  
>>>2ndly, you will never get close to 100% efficiency,  
>>  
>>93% efficiency motors have been built. Dumping the regen energy into  
>Over what RPM range is this motor >93% efficient? I've heard that efficiency  
>can vary by 50% over a given rpm range. And, of course, at zero rpm %eff = 0.

A properly designed switched reluctance motor that is totally computer controlled can continually control all it's coils. The flux intensity, polarity, duration, timing and how many coils need to be energized for a given load can all be controlled thousands or even eventually millions of times a second if needed. To the point that at any loading or RPM the motor can be considered peaked for that loading or RPM without the need of any transmission. 93% efficiency is real today and it should go even higher.

>  
>>capacitors can take much higher voltages and current or with other high  
>>current capable buffers, then reapplying that energy to accelerate the  
>>vehicle or just bleed the higher voltage to the batteries can be pretty  
>>efficient. This over voltage buffer and bleed also eliminates overcharge to  
>>the batteries. Also dual or even quad switched windings can change the  
>>characteristics of the motor on the fly, almost acting like a transmission to  
>>increase low RPM torque or step up the voltage at low RPM.

>  
>Flywheels are another potential source of storage for "topping" power.  
>Obviously, each technology would have to be weighed against the others to  
>determine what is best for which conditions.

Your 100% right!!!  
Composite flywheels in a vacuum using magnetic bearings have already reliably achieved 2-3 times the energy density of the best lead acid batteries. Amazingly even small units can store that rotational speed for

months. This gives you some idea of the efficiency they must have. The cost is still high but in a few years they could triple the range of today's EV's. But even better, the flywheels could be used for millions of miles or even lifetimes of use. They also can recharge and dump energy at 20+ times the rate of lead acid batteries per pound. I would not be surprised if they were incorporated into aircraft as propulsion some day. I have built many vertical take off 2-5 pound electric prop or ducked fan driven rockets that can reach 5,000 feet with ease using Nicads. I can't wait to get these things go several times higher with flywheels. A real "Rocketeer type" pack would be one of my first projects. As I can already get several small electric motors to lift human sized loads but with the batteries weight still on the ground. With flywheels for the energy storage it would make for quick short range troop deployment and or retreat in war situations.

>Sounds like you may want to modify your driving habits a little bit - all  
>cars have the potential for stalling when the gas pedal is tromped on. I  
>wouldn't have much problem with the car being shut off for a few minutes  
>and then asked to start and go real fast. Gas powered golf carts are made  
>this way, and don't seem to suffer from poor throttle response [ever cross  
>an intersection of angry golfers wanting to play through? And you thought  
>everyday driving could be dangerous :-)]

Every time you add a new system or component you usually add complexity and weight. Adding 100's of new innovative idea's to a IC engine makes it fuel efficient but is just making the system overly complex. With electric vehicles we can start from scratch building a car simple (and not a hot greasy complex mess to repair) with as little as 1% of the parts of today's vehicles components.

>>At low stop and go speeds without substantial wind-drag, tire/bearing drag  
>>and wasting all your stop and go momentum in brake heat. These are the only  
>>things really stopping a car from traveling almost forever. **Regenerative**  
>>braking will be a great tool for energy efficiency, especially in stop and  
>>go traffic and your understanding of physics is hindered by great amounts of  
>>skepticism of current technological achievements.

>Typical stop-go driving is going to be in the hot summer or the cold winter.  
>Your EV will have to supply either AC or heat to the passengers, if the car  
>is ever going to be acceptable. I'd guess the heat/AC will use most of  
>what you get from regen. braking, no matter how efficient it is.

>Consider that GM's Impact won't provide enough heat to keep passengers comfy  
>when the outside temp.'s below 20 F. This may be acceptable for 3/4 of  
>the U.S., but some of us live where it gets a bit colder than that...  
>>

AC and heat really reduce the range on electric cars. Trapping any heat resulting from inefficiency would be helpful. I wonder how hard it would be to steal the wasted heat off of tires with conduction material in the tread and or heat pumps. Most of an electric vehicles tires can be shielded from air flow unlike IC's that need air flow for heat dissipation of the braking system. Luckily strong light one piece composite designed bodies using foam cores can work like very high R-value insulation limiting heating/AC needs while providing great levels of noise attenuation.

Reed Mueller

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